POLICY AND REGULATORY FRAMEWORK FOR FIBER OPTIC BACKBONE IN ABUJA

BY

Alhaji UsmanIdris

(PG/PGD/05/27)

AProjectSubmittedinPartialfulfillmentfortheAwardof Post Graduate DiplomainICT
Department ofElectronicEngineering
University ofNigeria,Nsukka.

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SUPERVISOR

Engr. Prof. Anthony N. Nzeako

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CERTIFICATION

ThisistocertifythatU s m a n I d r i s ,apostgraduatestudentinthe DepartmentofElectronicEngineering,UniversityofNigeria,Nsukka,withregistration number**PG/PGD/05/27**hassatisfactorilycompletedtherequirementsforthecourse and research workfor Postgraduate Diploma (PGD) in Information & Communications Technology (ICT).

Theworkembodiedinthisprojectisoriginalandhasnotbeensubmittedinpartorin full for any other Diploma or Degree in theUniversity or any other University.

.....	……..
Engr. Prof. Anthony N. Nzeako	Prof. O. U. Oparaku
(Supervisor)	(Head of Department)
……	……..
Date	Date

DEDICATION

Thisproject is dedicated to the Omniscience the creator of the entire universe, who fought and inspire mankind with the knowledge of all things,Almighty Allah and to all seekers of sound knowledge.

ACKNOWLEDGEMENT

Mygratitudegoestomysupervisor,Engr. Prof. Anthony N. Nzeakoforhismeticulousand pragmatic supervisionofthisproject; to theHeadofDepartment of Electronic Engineering, Prof.O. U. Oparaku for hisefforts towards making this programme a success. I am also grateful to all the lecturers and staff of this department.

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To allmy fellowbatchoneICTstudents,for all theiruseful contributions to the success of this project, I say thank you.

Finally,to Almighty Allah for making this programme successful.

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ABSTRACT

The purpose of this work is to make a contribution to the "Abuja grand design" by proposing a strategy that would facilitate making Abuja feature as a "modern city". This proposal is entitled ***"Policy and Regulatory Framework for Fiber Optic Backbone in Abuja".*** The main import of the strategy is to network every home and business in Abuja with fiber optics. The city fiber network would serve as a broadband communication medium to provide essentially unlimited and open communication capacity to all residences and businesses in Abuja and beyond. High-bandwidth broadband is widely recognized as a key driver of future economic competitiveness, and is also regarded as a **facilitator of political discourse and activity. A fiber networking strategy for municipal public services (education, public health, public safety, etc.) would not only spur up private-sector innovation and competition, but also place Abuja among the world class cities, with a potential to ranking among the "international information capitals".

Comments:

** you don't quote references in the Abstract

Abstracts are usually ONLY ONE PARAGRAPH, and NOT MORE THAN HALF A PAGE, no matter how voluminous is the work (thesis).

*** ALL my corrections are put in RED. Look at them and if you agree with them, then CHANGE THEM INTO BLACK and produce the FINAL COPY FOR THE EXTERNAL EXAMINER.

**** WITH THESE FINAL CORRECTIONS, I THINK THE LONG JOURNEY HAS EVENTUALL BEEN COMPLETED. GOOD LOCK AND GOD BLESS

NZEAKO, JULY 23/07/2013

CHAPTER ONE
INTRODUCTION

1.1 Introduction

Abuja, the capital of the Federal Republic of Nigeria, could be classified as a modern city. The urban planning and built physical structures are comparable to those of most contemporary cities of the world, particularly in the sub-Saharan Africa. Compared to other cities in the country, the urban physical infrastructure, such as transportation, electricity, communication systems, water, sewage and garbage disposal facilities, could be rated as above national average. These, coupled with the seat of the central government in Abuja, are attracting a large influx of population, economic investments, and all sorts of social and commercial activities from all parts of the country into the city. Such is the rate of this influx that it is generally feared that Abuja would sooner or later surpass Lagos in such urban problems as commuting, crime, congestion and pollution. This fear is heightened by the concentration of government and business activities in a small number of districts, known as Areas and Zones or Abuja Central Districts. These districts, which are clustered with high rise administrative structures, many large commercial malls, and uncontrollable number of "illegal structures", constitute less than twenty five percent (25%) of the entire Federal Capital Territory (FCT), under the jurisdiction of the Federal Capital Territory Authority (FCTA). It was this fear that prompted the former Minister of FCTA to embark on the demolition of the alleged "illegal structures", particularly within the central districts.

At the same time the Honorable Minister came up with a "grand design" to make Abuja a "modern", "world class" city. This grand design includes, among other things, massive development of "satellite cities" in the suburbs of FCT, to decongest the central districts, the expansion of the physical infrastructure within the central districts and the development of new road networks and electricity connections between the central

districts and the satellite cities. However, the situation on ground shows that so far this "grand design" places no emphasis on one of the most prerequisite infrastructure for world class (modern) cities - the telecommunications infrastructure. As compared to all other major urban infrastructure investments in Abuja, direct and indirect government investments in the telecommunications infrastructure are least visible and documented. Urban infrastructure policies in the city (Abuja) have primarily focused on physical systems for the movement of people, water, cargo, and vehicles. More specifically, far more attention has been given to these other physical systems than to communication systems in policy formulation and regulation in Abuja. This leaves the design, development and operation of communications networks and services in the city (and indeed in the whole country) in the hands of a few regulated monopolies and central government agencies, leaving little or no roles and opportunities for either the FCTA or the local governments to intervene, whether through land use and "right-of-way" regulation or capital investment and assistance. The ongoing hue and cry about poor quality of telecommunications services, particularly the GSM services at Abuja, is a pointer to the apparent lack of due priority to the telecommunications infrastructure in the FCT.

The contributions of communications to urban growth have been acknowledged world wide. Global and historical trends have it that "the rise of the modern city is integrally linked to advances in communications technology. The operational boundaries of a city are no longer defined by geography or law, but by the reach of phone lines and computer networks. This makes present day cities synonymous with communication centers of the world, often times called "international information capitals" [1]. The emergence of such international information capitals is not measured by traditional criteria, such as population size, land area, or road networks for movement of people and goods. Rather the location of foreign banks, world class hotels and international organizations, the number of international visitors and long distance telephone calls,

and the provision of innovative, state-of-the art communications services may be a more barometer of a city's economic health and vitality [1]. Such cities are intricately linked to each other through sophisticated telecommunications networks that operate on an around-the clock basis. The face-to-face activities that occur in these cities have not been made obsolete by new technology; rather, communications technology has extended the geographic reach of the individuals and firms that transact business in these world capitals.

The purpose of this work is to make a contribution to the "Abuja grand design" by proposing a strategy that would facilitate making Abuja feature as a "modern city". This proposal is entitled ***"Policy and Regulatory Framework for Fiber Optic Backbone in Abuja".*** The main import of the strategy is to network every home and business in Abuja with fiber optics. The city fiber network would serve as a broadband communication medium to provide essentially unlimited and open communication capacity to all residences and businesses in Abuja and beyond. High-bandwidth broadband is widely recognized as a key driver of future economic competitiveness, and is also regarded as a facilitator of political discourse and activity [2]. A fiber networking strategy for municipal public service (education, public health, public safety, and other public use) and to spur private-sector innovation and competition would place Abuja among the world class cities, with a potential to ranking among the "international information capitals".

1.2 Problem Statement

Abuja has a unique identity. It is both a Federal Capital and seat of central government and a State, with limited autonomous state status, as well as a State Capital. This presents a complex, multi-layer policy and regulatory challenges and opportunities in communications infrastructure development, deployment and management. These

include: separation of power (authority), responsibilities and risks; identification, definition and differentiation of national versus state and local needs and development goals; and leveraging the great potential of communications and communications technologies for socio-economic development. Generally, unlike other physical infrastructures, such as road networks and transportation, where there are differentiations in roles and jurisdictions, both the national telecommunications policy and its regulation are centralized, with a regulatory agency – the Nigerian Communications Commission (NCC) that grants licenses to telecommunications operators and services providers and polices the national policy. Centralized in the sense that the Federal Government seems to be all and all in all issues relating to telecommunications at the three tiers of government, from local government areas to states and to the central federal government at Abuja.

This raises the question as to whether states and local governments could have any say in communications infrastructure development and management in their states and local government areas (LGAs), respectively, as they do in roads and other utilities infrastructure, such as pipe water, sewage and electricity transmission netwoks, where you have such arrangements as federal, state and LGA roads, or national grid and rural electrification networks, respectively, in co-existence. In other words, could states and local governments have separate (or be granted limited autonomy in) communications policies and regulations, which might be tailored to their peculiar circumstances? The adoption and deployment of fiber optic communication backbone for Abuja is a case in point: Could there be an FCTA fiber-optic-backbone policy and regulation that might be separate from but under the umbrella of those of the central Federal Government? What are the challenges and opportunities for such a framework? These are some of the questions explored in this study, whereby a number of the above challenges and opportunities have been identified, defined, differentiated and presented for possible

adoption and exploitation for the growth of the national telecommunications industry and market and for the benefit of all the stakeholders (FCTA, the Federal Government, telecoms operators and services providers, and consumers). It is believed that such a framework could not only enhance the status of Abuja as a truly modern city and an international information capital, but also serve as a model for other states/LGAs in the Federation.

1.3 Aims and Objectives of Study

Theaimofthisresearchistodevelopguidelines and present good practices to enable those in government and authority formulate an appropriate policy and regulations for the development, deployment and operation of a *Fiber Optic Backbone for the Federal Capital City, Abuja*. Specifically, the objectives ofthis studyare:

1. To proposea Framework (guidelines and good practices) for the Formulation and Regulation of a Policy for Fiber Optic Backbone in Abuja
2. The proposed framework includes the identification of
   - the infrastructure to support effective communication system in Abuja.
   - the best formof broadband communication medium, and
   - communications infrastructure development strategies asimplemented in other capital cities of the world

1.4 Significance of Study

Thisstudyprovidesareferenceforanyoneinterestedin(or charged with the responsibility of) formulating a policy and regulations for thedevelopment, deployment and operation of a Fiber Optic Backbone in any capital city like Abuja. This includes, but is not limited to:

- Policy makers in the telecom sector
- Town and capital city planners

- Consultants, and other professionals in telecommunication
- Researcherson telecom policy and regulations, with a focus on Fiber Optic Backbones in big cities like Abuja
- Regulatory Agencies in the communication sector

1.5 Scope of Study

Thefocusofthisstudyisonproposing a framework for a***Policy and Regulations for the development, deployment and operation of a Fiber Optic Backbone in Abuja.***The main import of the framework is to network every home and business in Abuja with fiber optics.

1.6 Outline uf Study

The workhas been organized into five chapters as follows: 1. Introduction,2. Literature Review, 3.Fibre Optic Deploymentin Capital Citiesin the World 4. Policy and Regulatory Framework of Fiber Optic Deployment in FCT,and5.Observations and Recommendations.

Chapter Two
Literature Review

2.1 Broadband Access

Broadband communication has radically transformed the way internet is being used globally by providing the ability to access voice, video and data through a single network. There are a number of compelling reasons for promoting broadband access and adoption in some cities like Abuja. Notable, there are benefits in having access to educational institutions, telemedicine application, e-commerce, Government etc. and this has made several states in developed countries to devise several strategies to encourage telecommunication service providers to expand broadband service to unserved areas, offices, schools, malls and homes. This necessitated the conception and deployment of fiber to the home FTTH technology. Some of the strategies adopted in achieving these wonderful ideas are:

1. Establishing a task force of public and private stakeholders to evaluate the status of broadband deployment and identify useful policy framework.
2. Provision of tax incentives that will encourage investment in broadband infrastructure as well as other related equipment and expenses.
3. Creation of dedicated funds that will allow states to leverage private sector funds for investing in the infrastructure, which will ultimately maximize their retion as investment (ROI) and expanding broadband availability in the most efficient way possible.

4. Designing and mapping broadband availability to help both policy makers and service providers determine where to focus their efforts and reveal gaps in service to providers who wish to expand their offerings.
5. Engaging the community through public private partnership to increase customers' demands which will encourage providers to deploy broadband across board.

The above strategies were deployed by various states to encourage providers to expand broadband access. An overview of the implementation of these strategies is presented in the following sections.

2.1.1 Creation of Taskforces to leverage Public and Private Expertise.

The taskforces have proved to be effective at evaluating the status of broadband deployment and identifying possible regulatory changes to increase service availability. Some of these taskforces have been created by Governors' as in California where the Governor Arnold sc… created in 2006 the California Broadband Taskforce executive orders as in California and Missouri or by legislation as in Hawai and Maryland. The Taskforce usually comprised of Government representative, service providers, investors, stakeholders in the telecommunication companies and members of the legislatives. Depending on the period given to the task forces, theyare expected to produce a report that will include among others:

(1) The baseline assessments of the initial broadband deployment and policy recommendation for achieving access and increased adoption

(2) The creation of regional broadband maps that should detail broadband availability and speed of connection

(3) The examination of broadband expansion initiatives and determine the type of resources and infrastructure investment that will work best for the city,

(4) The development of proposals, legislation and procurement policies that might further the goal of broadband proliferation in the city,

(5) The creation of a public-private partnership to oversee the planning and deployment of a fiber-Optic network that will improve the economic feasibility of providing last mile service to the community.

The cities that created taskforces in order to enhance broadband access include California, Maryland and Hawaii.

2.1.2 Task incentives for Broadband infrastructure and related expenses.

In some states, taxes were augmented in order to encourage investment in broadband infrastructure and other related equipments. For example, Mississippi, provided tax credits and sales task exceptions for investment made from June 30, 2003, through July 1, 2013, on equipment used for the deployment of broadband technologies. The tax credits rang from 5 percent to 15 percent while the sales tax exemption range from 50% to 100%

2.1.3 Creation of Dedicated fund to attract service provider.

Some states have created funds to help encourage private sector investment in broadband infrastructure. Matching grants is being employed to improve the financial feasibility for service providers to expand operation to unserved areas. For example in California, a California Advanced Service Fund (CASF) was established by the California Public Utilities Commission in Dec. 2007 as a two year program to facilitate broadband deployment in unserved areas of the state. A total of $100 million was allocated to provide matching funds of up to 40% of the total project cost for the deployment of the broadband infrastructure.

It must be stated clearly that only fiber optics and FTTH can guarantee the delivering of broadband access to either unserved or underserved area of a state which ultimately will enhance effective running of business between all strata of the society.

2.1.4 Community and Public Private Partnership Strategy.

Many states have involved their communities to encourage broadband adoption as practiced by Kentucky's broadband initiative. Through these strategies, a comprehensive map of broadband availability was created and local volunteers were used to develop community plan that help bridge the gap between the served and underserved areas.

CHAPTER THREE

Fibre Optic Deployment

3.1 Fibre Optic Deployment in Capital Cities in the World

The rise of the modern city is integrally linked to advances in communications technology: the telephone was essential to the development of the office building, the key architectural innovation of the twentieth century city. Prior to the telephone, human messengers were the primary means of bringing information into and out of office buildings. As one observer wrote in 1908, 'Suppose there was no telephone and every message had to be carried by a personal messenger. How much room do you think the necessary elevators would leave for offices? Such structures [skyscrapers] would be an economic impossibility.' (Pool, 1980).

Despite the contribution of communications to urban growth, far more attention has been given to transportation systems than to communications systems in the study of cities. There exists a considerable geographical literature on the analysis and design of transportation networks, but there is no comparable literature on communication networks' (Abler, 1974). Although investing in urban infrastructure is widely regarded as a means to stimulate urban development, urban infrastructure policies have primarily focused on physical systems for the movement of people, water, cargo, and vehicles. 'As compared to all other major urban infrastructure investments, the telephone impact is the least documented, even though it is just about the oldest and the most familiar' (Meier, 1985).

The telecommunications infrastructure which includes the wires, ducts, and channels that carry voice, data, and video signals remains a mystery in most cities. In part, this is due to the fact that key components of the telecommunications infrastructure, such as underground cables and rooftop microwave transmitters, are not visible to the public (Blazar, Spector, and Grathwol, 1985). Unlike airports and garbage disposal plants,

telecommunications facilities are not known for their negative side effects, and, until recently, have not been the source of public disputes and controversy. Moreover, the predominant role of either regulated monopolies or central government agencies in the design and development of communication facilities has meant that there have been few opportunities for local governments to intervene, whether through land use regulation or capital assistance. Airports, highways, and subways, by contrast, regardless of their funding source, are highly visible elements of the urban infrastructure that typically fall under the jurisdiction of one or more local and regional agencies. This situation is gradually changing, as public agencies have come to recognize the importance of communications in economic development and, as citizens groups have expressed concerns about potential health hazards from telecommunications facilities.

More than a quarter of a century ago, Meier observed that 'an intensification of communications, knowledge and controls seemed to be highly correlated with the growth of cities' (Meier, 1962). Although Meier emphasized the need for systematic measures of the transactions that occur in cities, with the notable exception of Abler, Pred, Goddard and Gottmann remarkably little empirical work on communications within and among cities has been done. One area which has received considerable attention has been the relationship of communications to the location of offices (Goddard, 1975; Goddard and Pye, 1977; Hepworth, 1986; Pye, 1979; Thorngren, 1977).

3.1.1 Optical Fiber Systems and Cities

In the United States, a telecommunications infrastructure is being built that relies on optical fiber rather than traditional pairs of copper wire. Among the advantages of optical fiber systems are their large carrying capacity, the speed at which they transmit information, their signal strength, and their high security. The current state of the technology and the economics of fiber favor high-volume point-to-point

communications from one hub to another hub. As a result, the new optical fiber systems are initially being built to serve the heavily used communication routes, typically those linking major cities, further enhancing the comparative advantages possessed by these centers. This pattern of development is in sharp contrast with communication satellites, where the technology favors traffic from one point to multiple points or vice versa. 'Geostationary satellites lean towards the creation of a more equitable and decentralized communications network, optical fibers lean more to the heavy routing of messages and to more centralized patterns of communication, preferring only fixed sources and receivers' (Podmore and Faguy, 1986).

Just as telegraph systems were installed alongside railroad tracks in the nineteenth century, optical fiber systems are being installed along the transportation rights-of-way of railroads, waterways, highways, and even bicycle paths (Moss, 1986a). In the United States, MCI has built its Northeast fiber system along the AMTRAK right-of-way; Cable and Wireless is using the right-of-way of the Missouri-Kansas-Texas Railroad to connect the Texas cities of Austin, San Antonio, Dallas, and Forth Worth; and optical fiber has also been installed along the Ohio Turnpike. The US Department of Transportation has proposed that the rights-of-way of the federal interstate highway system be made available for communication systems.

Fiber optic systems are also being built for intra-urban and intra-building communications. New York Telephone has built three fiber optic networks around Manhattan and an interborough fiber network that links the counties adjacent to Manhattan. At the same time, Teleport Communications Inc. has installed 150 miles of fiber in the New York-New Jersey Metropolitan Area that not only provides access to their communications satellite park, but also serves as an alternative to the intraregional public switched network. In Washington, D.C., an optical fiber communications network linking federal government offices is to be built using the rights-of-way of

underground steam tunnels, and in Chicago, a fiber optic is being installed in the coal tunnels below Chicago's business district. 'Once primarily a physical crossroads, the new metropolis is likely to become more important to us as an electronic crossroads for information processing and exchange' (Hicks, 1985).

A parallel pattern of infrastructure development is underway in the United Kingdom where the new competitor to British Telecom, Mercury Communications, anticipates that its 'initial customers will be businesses located within the city of London' (Jonscher, 1984). Mercury Communications is building a fiber system with hubs in London, Manchester, and Birmingham, that uses the rights-of-way of British Rail to link cities, and the unused ducts of the London Hydraulic System for its fiber system within London. In Western Europe as a whole, the emergence of new communications technologies is heightening the regional differences in the availability of advanced telecommunications. As is the case in the United States, the new optical fiber systems will not serve all cities initially, and may even exacerbate the disparities that exist between information-based cities and the declining manufacturing cities, "There is little to indicate that development in telecommunications networks are likely to disadvantage the largest cities relative to small towns and rural areas in any national urban and regional system. The incremental modernization of networks and the logic of density will ensure that the inner parts of large cities will have an initial advantage in an increasingly commercial environment. (Goddard, Gillespie, Thwaites, and Robinson, 1986).

3.1.2 Deploying Citywide Fiber-Optic Networks

The Internet search giant, Google has offered to install fast Internet access via fiber-optic lines to a few cities of its choosing. The eager supplicants include Los Angeles; Topeka,

Kan.; Duluth, Minn.; Baltimore; Pittsburgh; Santa Monica, Calif.; Asheville, N.C.; Oklahoma City; Madison, Wis.; Sarasota, Fla.; Seattle; Austin, Texas; and Fresno, Calif.

As a test project, the California company plans to offer high-speed service of 1 GB per second--100 to 1,000 times faster than most current "high-speed" Internet service of 1 to 10 MB per second--to 50,000 to 500,000 people at low cost. The possibilities of such a service are immense for residents, businesses and government.

There is, however, a question that no one is asking: Why don't towns and cities just do it themselves? Cities, like Google, are corporations, and they have money and power to build broadband infrastructure, including laying fiber-optic lines.

This is not a new argument. Municipalities have successfully built and run public utilities for decades. The Los Angeles Department of Water and Power serves approximately 4 million residents and contributes some $200 million annually into the city's coffers, all with reasonable utility rates. During the deregulation wars in California over the last decade--when private electricity companies jacked up rates more than tenfold in some areas--Los Angeles residents were immune to such tactics.

The capital investments are not minor, but neither are they out of the question. Clearly great advantages will accrue to any city or region that offers lightning fast Internet access to all its citizens and businesses at a low cost. Google's website paints an amazing picture: "Imagine sitting in a rural health clinic, streaming three-dimensional medical imaging over the Web and discussing a unique condition with a specialist in New York, or downloading a high-definition, full-length feature film in less than five minutes."

Infrastructure is one of the primary ways that towns, cities and states can make themselves more competitive. Build the right thing at the right time, and new residents, jobs and businesses will come. But this terrain is rife with strife. A century ago, towns

and cities started public power companies, and saw private power companies resist such efforts in courts and with legislation. Today many of these public power companies are doing quite well, thank you very much, as exemplified by the Los Angeles Department of Water and Power and others in small towns.

In the 1930s, President Franklin Roosevelt attempted to make the formation of public power companies government policy as a way to push private companies to keep rates down and spread the economic benefits of plentiful power. But as it occurred with the "public option" in the recent health-care battles in Congress, powerful interests pushed such an option off the table. Roosevelt did get Congress to pass laws encouraging the formation of rural electric cooperatives, many of which are still operating in places like Minnesota and Wisconsin.

What water and power were in 1910 or 1930, Internet access is in 2010. Cities like FCT, Abuja needn't wait for Google like a home-bound Cinderella waited for her prince to rescue her from her ashes and sack clothes. Cities and towns could deliver such services more cheaply and comprehensively than private companies, and even more importantly, could spark new business ventures within their borders in ways impossible to calculate.

Some towns and cities already have ventured into this rich but dangerous terrain. The Minnesota Supreme Court affirmed in 2009 the right of Monticello, a suburb of Minneapolis with about 10,000 people, to lay its own fiber-optic lines, something its citizens chose in a referendum for a project dubbed "FiberNet Monticello.

The logic here is outrageously contradictory. Usually opponents say that because government may be able to provide service more cheaply and better, it should not be allowed to do so. But when private companies can claim to provide something more cheaply, such as prisons, then they should be allowed to.

The intricacies of Internet connectivity are many, and I don't pretend to be an expert in them. But the broad outlines are clear: An opportunity exists for localities to take charge and not wait on private companies, including Google, to implement fiber-optic networks. Right now our reluctance to venture into these areas keeps our country behind. The Information Technology and Innovation Foundation ranked the United States 15th in the world in how well its citizens are provided Internet access. By comparison, once third-world South Korea now leads globally in providing fast and cheap Internet access, largely because its government has not hesitated to get involved.

3.1.3 Fibre Optic Deployment in Abu Dhabi

Abu Dhabi is now the first capital city in the world which is entirely covered with a fibre optic network (FTTx). The completion of this project marks a new milestone and achievement for the country. The UAE is being ranked amongst the top five countries in the Arab world in the Network Readiness Index (NRI) and ranked 24th globally, according to the Global Information Technology Report 2011 issued by the World Economic Forum.

This new achievement opens the doors to a new era in the telecommunications sector due to the enormous potential offered by fibre-optic networks, which can contribute to the economical and social development of nations and enhance economic progress and prosperity.

Fibre offers revolutionary services and solutions which can meet subscribers' needs for decades to come.

Nasser Bin Obood, etisalat's acting CEO, said: "The fibre optic network is a key turning point in the development of telecom infrastructure, as this network with all its enormous benefits and features is expected to have an impact in all sectors."

After etisalat launched the first of its services based on this network in 2009 — eLife — which offers fixed line, internet and TV services in a single subscription with better service quality, high reliability and speed, the corporation received significant demand and acceptance of the service. It now effectively services more than 230,000 subscribers.

3.1.4 Fibre Optic Deployment in Kigali

Alloptic Inc., a pioneer in the development and deployment of Ethernet passive optical networks (ePONs) announced that Terracom has begun a nationwide rollout in the central African country of Rwanda. Terracom's initial deployment of the Alloptic fiber access network will be in the capital city of Kigali with initial emphasis placed on providing fiber connectivity to schools, government offices and foreign embassies. "We are pleased to be working with the Rwandan government and President Paul Kagame to provide Rwanda with a world class communications infrastructure" said Greg Wylar, American entrepreneur, philanthropist, and driving force behind Terracom. "With one of the most stable governments in Africa, Rwanda has lacked a communications infrastructure. This massive fiber optic build-out is making Rwandan communications comparable to the infrastructures deployed in the United States and far ahead of any other country in the region. Call centers and businesses are looking to relocate in Rwanda because the communications systems are by far the best in the region.

3.2 The Need for Fiber Optic Deployment in FCT

In Nigeria, just like in most of sub-Saharan African Countries, backbone infrastructures are used by the operators that built and owned them. A wholesale market in backbone capacity are poorly developed as very few examples of joint ventures on the construction and operation of terrestrial networks and there is very little sharing of backbone network facilities. Consequently this has lead to show penetration of broadband connectivity and services for the benefit of the interested customers. The

FCT which is the capital city and the mirror of the country can not and should not be allowed to trail behind the present slow rate of penetration of broadband services caused by private operators.

The backbone infrastructure being deployed by the private operators in FCT has defied all standards by not being adequate and affordable. The deployment by the operators is limited to their area (length) of interest and does not cover the entire geographical area of the city. And the capacities of the backbone not guarantee the provision of several services other than the voices and limited data (internet) transmission. In view of the fact that these deployed backbone network are entirely owned by the provider, they are largely unaffordable and does not allows for the interconnectivity by other service providers hence completely renouncing competition in the industry.

This monopolistic tendency being demonstrated by the service providers and the inadequacy of the capacity and expensive nature of their backbone infrastructures should not be allowed to be sustained in FCT as it will slow down the pace of development of the capital territory. It is therefore imperative that the FCT administration urgently consider the need to undertake the provision of the backbone infrastructures in the entire city through collaboration with other operators and other stakeholders. This will eventually spar up development in all areas of Governance, business, economy and security surveillance in the city. Above all, a lot of revenue will be generated by the FCT through the leasing or sale of bandwidth to other operator or directly to end users.

The backbone infrastructure so deployed by the FCT will largely be owned by it and will forms the integral component of broadband connectivity in the FCT with the capacity to carry the aggregate traffic between all the network nodes. The other advantages associated with the FCT backbone infrastructure includes but not limited to the followings:

(a) Affordability: The FCT backbone network, that will cover the entire city including the underserved area, will have the required capacity to lease bandwidth to various interested operators. This will alternately enhance competition in the industry and eventually make the prices affordable for the consumers

(b) Uniform Access: As the backbone network will cover the entire city, access will be guarantee to all Government and non-Government agencies, together with all houses at the same time.

(c) High Capacity of the Network: This will be ensured in order to all the unlimited aggregation of traffic on backbone networks through a wholesale market or network sharing.

(d) Smart City: in view of the capacity and the coverage area of the backbone network, security in the city will be guaranteed and smooth and transparent running of both Government and other private business will be ensured. And the FCT will transform into a Smart City Similar to Singapore.

(e) Revenue Generation:

3.2.1 Fiber Optic Deployment in FCT

Broadband communication has radically transformed the way internet is being used globally by providing the ability to access voice, video and data through a single network. There are a number of compelling reasons for promoting broadband access and adoption in certain cities like Abuja. Notable, there are benefits in having access to educational institutions, telemedicine application, e-commerce, Government etc. and this has made several states in developed countries to devise several strategies to encourage or incentivize telecommunication service providers to expand broadband service to unserved areas, offices, schools, malls and homes. This necessitated the

conception and deployment of fiber to the home FTTH technology. Some of the strategies adopted in achieving these wonderful ideas are:

6. Establishing a task force of public and private stakeholders to evaluate the status of broadband deployment and identify useful policy framework.
7. Provision of tax incentives that will encourage investment in broadband infrastructure as well as other related equipment and expenses.
8. Creation of dedicated funds that will allow states to leverage private sector funds for investing in the infrastructure, which will ultimately maximize their retion as investment (ROI) and expanding broadband availability in the most efficient way possible.
9. Designing and mapping broadband availability to help both policy makers and service providers determine where to focus their efforts and reveal gaps in service to providers who wish to expand their offerings.
10. Engaging the community through public private partnership to increase customers' demands which will encourage providers to deploy broadband across board.

The above strategies were deployed by various states to encourage providers to expand broadband access. An overview of the implementation of these strategies is presented in the following sections.

1. Creation of Taskforces to leverage Public and Private Expertise.

The taskforces have proved to be effective at evaluating the status of broadband deployment and identifying possible regulatory changes to increase service availability. Some of these taskforces have been created by Governors' as in California where the Governor Arnold sc… created in 2006 the California Broadband Taskforce executive orders as in California and Missouri or by legislation as in Hawai and Maryland. The

Taskforce usually comprised of Government representative, service providers, investors, stakeholders in the telecommunication companies and members of the legislatives. Depending on the period given to the task forces, the expected to produce a report that will include among others: (1) The baseline assessments of the initial broadband deployment and policy recommendation for achieving access and increased adoption (2) the creation of regional broadband maps that should detail broadband availability and speed of connection (3) the examination of broadband expansion initiatives and determine the type of resources and infrastructure investment that will work best for the city, (4) the development of proposals, legislation and procurement policies that might further the goal of broadband proliferation in the city, (5) the creation of a public-private partnership to oversee the planning and deployment of a fiber-Optic network that will improve the economic feasibility of providing last mile service to the community.

The cities that created taskforces in order to enhance broadband access include California, Maryland and Hawaii.

3 Task incentives for Broadband infrastructure and related expenses.

In some states, taxes were augmented in order to encourage investment in broadband infrastructure and other related equipments. For example, Mississippi, provided tax credits and sales task exceptions for investment made from June 30, 2003, through July 1, 2013, on equipment used for the deployment of broadband technologies. The tax credits rang from 5 percent to 15 percent while the sales tax exemption range from 50% to 100%

4 Creation of Dedicated fund to attract service provider.

Some states have created funds to help encourage private sector investment in broadband infrastructure. Matching grants is being employed to improve the financial

feasibility for service providers to expand operation to unserved areas. For example in California, a California Advanced Service Fund (CASF) was established by the California Public Utilities Commission in Dec. 2007 as a two year program to facilitate broadband deployment in unserved areas of the state. A total of $100 million was allocated to provide matching funds of up to 40% of the total project cost for the deployment of the broadband infrastructure.

It must be stated clearly that only fiber optics and FTTH can guarantee the delivering of broadband access to either unserved or underserved area of a state which ultimately will enhance effective running of business between all strata of the society.

5 Community and Public Private Partnership Strategy.

Many states have involved their communities to encourage broadband adoption as practiced by Kentucky's broadband initiative. Through these strategies, a comprehensive map of broadband availability was created and local volunteers were used to develop community plan that help bridge the gap between the served and underserved areas.

3.2.2 Advantages of Fiber Optic over Copper

Fiber Optics have found many uses in a varieties of industries with profound effect in telecommunications. Originally, Fiber Optics, is considered by many to be a prohibitively expensive technology in practical appreciation, but has now tremendously transformed the communications technology. And this is because of the following advantages it has over copper viz:

1. *Enormous potential bandwidth*: the optical carrier frequency in the range 1013 to 1014Hz offers the potential for a fiber information carrying capacity that is many orders of magnitude in excess of that obtained using copper cable or wideband

radio systems. This enables fibers to simultaneously carry voice, data, image and video signals.

2. *Small size and weight*: an optical fiber is often no wider than the diameter of a human hair; thus even after applying protective layers, they are far smaller and much lighter than corresponding copper cables. This is a tremendous boon to alleviating duct congestion in cities.

3. *Immunity to interference and cross talk*: they form a dielectric and are therefore free from electromagnetic interference.

4. *Signal security*: as light from a fiber does not radiate significantly, a transmitted optical signal cannot be obtained non-invasively, thus ensuring a high degree of signal security.

5. *Low transmission loss*: with losses as low as 0.2 dB/km, this feature alone has become a major advantage of optical fiber as extremely wide repeater spacing (70 to 100km) may be used in long-haul communication links. This in turn reduces both system cost and complexity.

6. *System reliability and ease of maintenance*: due to the low loss property, system reliability is generally enhanced in comparison to conventional electrical conductor systems. Furthermore, reliability of optical components have predicted lifetimes of 20 to 30 years. Combined, these factors tend to reduce maintenance time and costs.

7. The ability to carry much more information and deliver it with greater fidelity than either copper wire or coaxial cable.

8. The Fiber is totally immune to virtually all kinds of interference, including lightning, and will not conduct electricity. It can therefore come in direct contact with high voltage electrical equipment and power lines. It will also not create ground loops of any kind.

9. As the basic fiber is made of glass, it will not corrode and is unaffected by most chemicals. It can be buried directly in most kinds of soil or exposed to most corrosive atmospheres in chemical plants without significant concern.

10. Fiber optic cables are virtually unaffected by outdoor atmospheric conditions, allowing them to be lashed directly to telephone poles or existing electrical cables without concern for extraneous signal pickup.

11. A fiber optic cable, even one that contains many fibers, is usually much smaller and lighter in weight than a wire or coaxial cable with similar information carrying capacity. It is easier to handle and install, and uses less duct space. (It can frequently be installed without ducts.)

12. Fiber optic cable is ideal for secure communications systems because it is very difficult to tap but very easy to monitor. In addition, there is absolutely no electrical radiation from a fiber.

3.2.3 Application of Fiber Optic Network Deployment in FCT

A. Economic Development

The Fiber Optic network infrastructure has the potential of linking all the domestic and business building in the FCT by offering them high band width that is affordable. And this will alternately attract many software companies, video production houses, digital media shops and application services providers. This will equally enhance the city economic development in the area of both national and global competition for business. And as a justification to the statement "where go businesses, there follow jobs", the business attracted by the Fiber, will bring sustainable spillover benefits throughout the entire territory, in the form of jobs, retail and restaurant offerings and real estate appreciation.

B. Small Business

The small, entrepreneurial, local firm that specializes in creating digital effects will need ultra-high speed broadband to seamlessly integrate its offices with its other branches in order to send its high bandwidth products to its film studio clients. In the current situation, this type of connection will almost be impossible or cost the firm hundreds of thousands of Naira per to have a leased and dedicated phone line. And in the alternative, the company will be reduced to sending hard drives by overnight mail to its customers or remote offices.

However an available Fiber network will enable the small business offices to negotiate with multiple service providers to get the service it needs at an affordable price which enables it to operate and satisfy its customers without any constraints.

C. Public Health

The City's public health institutions and hospitals, with an available fiber network, get a mesh of true broadband connection, between all of its locations could simultaneously new and discus x-rays. Simultaneously, surgeons could video-conference to watch and advice colleagues during emergency surgery from distant locations. And multi-lingual

translators could be available over video-conference to translate and interact with patients throughout the city, not just in the primary hospitals where such translators are currently working.

D. Education:

Presently, the schools in the Federal Capital Territory, whether primary secondary or tertiary, lacks internet connectivity, and hence can neither deliver or conduct researches on courses online or even share its academic resources with other sisters schools. But with a fiber network, run through the premises (FTTP), students and teachers could download or upload or share academic resources with other schools seamlessly. And this will alternately enhance and maintain a high level qualitative academic course delivery and standard throughout the territory.

E. Public security

Fiber network that runs through the Federal Capital Territory is not only crucial for public safety and security through the linkage of various security outfits for effective and time delivery communication services. The use of leased levies, does not only have a prohibitive cost, but its unreliable, mostly unavailable at the time of needs and takes time to repair.

Fiber could make possible expansion and increased capacity of the territory's wireless public safety and security to high-use special events that require interoperable communications among the fire, police and emergency response personnel.

F. e-Government:

The e-Government platform being advocated for by various levels of Governments authorities through their recent policy statements, can hardly be realize through either a leased line network across the territory, government businesses can be carried out seamlessly through all its ministries. And this will guaranty transparency and capacity building of all the government officials.

CHAPTER FOUR

Policy and Regulatory Framework for Fiber Optic Deployment in FCT

4.1 Policy Framework

The starting point of the information-based economic development strategy for the FCT involves taking the decision to use information technology to harness economicgrowth. This should be done by moving beyond rhetoric to strategizing and implementing key policy changes in the telecommunications regulatory framework, nurturing a stable politicalenvironment (which impacts greatly on attracting foreign investment), and creating solid fiscal and monetary policies. Privatization of the public sector has already been started in the power,education and tourism sectors. Through a national information and technology policy, privatization should be initiated and implemented in the telecommunications sector.

Appropriate technology diffusion will emanate from appropriate government policy, implementation of a national information technology strategy and adequate sustainable information technology investments. Investments in information technology cannot be considered in a vacuum without assessing the national wealth of the country and how to create or have access to investment fund. National wealth is largely impacted by governmental policies, which create the environment with which to accumulate investment fund at home, and attract foreign investment and joint ventures. Once the above-mentioned information technology investments and concerted policy changes are in place, wage levels and employment growth rates will rise. The governmentôs investment in human capital, by creating more opportunities for people to train in information technology, will help to boost the territoryôs information technology capability. This will require a commitment by government to put in place and implement a sustainable information technology strategy to build an IT infrastructure using

optical fiber for the entire educational sector, a plan for IT training, management and use. This will require strategic partnership with the private sector and relevant government and parastatals. This enhanced information capability will impact upon cultural and social structures, changing peopleôs expectations and demands of their government. This, in turn, will impact upon government policies.

The governmentôs role is central to the development of information technology in developing countries by providing political stability and the regulatory and legal framework to allow IT to flourish. The governmentôs role in ensuring that education policy takes into account the human capital needs of an information economy is also important. Governments indeveloping countries can develop and implement Information technology policies through a National Information Infrastructure (NII) board.

4.2 Regulatory Framework

Telecommunication networks around the globe are in transition from traditional public switched telephone networks to modern IP-based next-generation networks.This transition started in the backbone networks where increased demand led to a capacity shortage and the need for new fiber optic technologies. At present, fiber is standard in the backbone infrastructure,
but the so-called last mile between the customer and the main distribution frame is generally still copper-based.The last mile is usually owned by the incumbent telecommunication carrier. However, due to the convergence of media and, eventually, increasing demand for high-speed Internet access, the last mile, too, has finally reached its physical limit and upgrading it to fiber is necessary. Eventually, the substitution of copper wire by fibre optic on the last mile, i.e., the construction of next-generation access networks, will complete the transition to the next-

generation network. This development raises the question of whether next-generation access networks should be regulated.

4.2.1 The structure of the last mile

The last mile is built hierarchically. Currently, many customers are connected via copper wire to a street cabinet; from there, the copper wires are bundled to the main distribution frame (MDF). At the MDF, the copper wires are connected to the fiber network via a digital subscriber line access multiplexer (DSLAM). The last mile is usually owned by the incumbent telecommunication carrier; however, the fiber backbone network may be owned by a competitor who, at the MDF, connects the customer, who has just ñtraveledò over the incumbentôs last mile, to its own fiber backbone network in a process known as local loop unbundling (LLU). Depending on the distance between the MDF and customer, a bandwidth of up to 16 MB/sec can be realized.

Bandwidth over the last mile can be increased by substituting fiber optics for the copper wire between the MDF and the street cabinet and installing a DSLAM inthe street cabinet (fiber to the curb [FFTC]). This strategy makes possible a bandwidth up to 50 MB/sec (VDSL). Installing fiber optics for the entire distance between the MDF and the customer (fiber to the building [FTTB], or fiber to the home [FFTH]) removes any last-mile bandwidth restrictions (at least temporarily). With the completion of the next-generation access network (NGA), many components of the traditional access network become obsolete, including the MDFs,thus reducing the networkôs operating costs. This reorganization also affects competitors and their business models, of course, since they can no longer ñpick upò their customers at the MDF.

How the incumbent telecommunication carrier arrives at NGA is heavily dependent on three factors: the structure of the traditional telecommunication network (i.e., the distance between

MDFs and customers or the availability of alternative infrastructure), the demand for high-speed Internet and the regulatory framework for the NGA. Competitors with their own backbone network may either imitate the incumbentôs strategy or engage in their own roll out strategy, a strategy often pursued by public utilities that use their own ducts and sewers to rollout a FTTB/FTTH network.

4.2.2 Roll-Out Strategies and Regulatory Framework for NGAs in Europe:

Germany

InGermanyin2007, therewere22.6 broadbandsubscribersper100inhabitants(Bundesnetz-agentur2009).With a share of nearly 92percentofthemarket,DSLclearlyis thedominant broadbandaccesstechnology(Bundesnetzagentur2009).Broadbandaccessviacable has become more important sinceDeutscheTelekomsolditscablenetworkin2003.Bytheendof2008,nearly1.6millioncablebroadbandconnectionswereinuse(Bundesnetzagentur2009).Among theDSLproviders,DeutscheTelekom hasa marketshareofabout 51 percent,DeutscheTelekomôs resellershave amarket share ofabout 8percent, andcompetitorswithowninfrastructurehaveamarketshare ofabout 37percent(Bundesnetzagentur2009).Thelatter usuallyhaveaccesstoDeutscheTelekomôslastcoppermileattheMDFs.Additionally,somecarriers (e.g.,Net Cologne,Wilhelm.tel)inlargeGermancities provideFTTB.These carriersoftenusethemunicipal utilitiesôductsandsewerstorollouttheirownfiberaccessnetwork. In2005,Deutsche Telekomstarted torolloutfibertothestreet cabinets inorder toofferVDSL inlargeGerman cities.Where thishashappened,thetraditional street cabinets havebeen replaced bybiggercabinets that nowaccommodate the

DSLAMs.Dependingonthedistancebetweentheconsumerandthestreetcabinet,thistechnologyper mitsabandwidth ofupto50MB/sec.Sofar,theupdatedstreetcabinetsareconnected totheMDFbybothfiberandthetraditionalcopperwire.CopperwireisstillcurrentlyusedbyDeutscheT elekom,itsresellersanditscompetitorstoofferaccessatabandwidth of16MB/sec.Eventually,however,thecopper wirewillbecomeobsoleteandwhenitsusebetween thestreet cabinet andthe MDF is phased out,the verysurvival ofDeutsche Telekomôscompetitorswillbeindoubt.Therefore,the German regulatory agency,Bundesnetzagentur,aims to set incentives for more transparencyregarding DeutscheTelekomôsroll-outplansforthefiberaccess network (Bundesnetzagentur2008). TheBundesnetzagenturdidnotwanttoforceDeutscheTelekomtoallowcompetitorsaccesstoitsnew fiberaccessnetwork.However,theEuropeanCommission filedanaction against Germany,which,inturn,required Bundesnetzagenturtomandatesubsidiaryaccess (Möschel2007;CullenInternational2007),thatis,DeutscheTelekommustgrantaccessto itsducts sothat competitorscanrollout their own fibertothestreet cabinetwithinDeutscheTelekomôsducts.Whenthereisinsufficientspaceintheductsto make thisfeasible,DeutscheTelekomisrequiredtograntaccesstoitsownunused fiber(darkfiber).At thestreet cabinets, competitorshaveaccesstothecopper pairsthatconnectthecustomerstothestreet cabinets.However, acompetitorisrequiredtobuilditsownstreet cabinet andinstallaDSLAMifspace willallow.DeutscheTelekomclaimsthat themandated subsidiaryaccesstoitsnewfibernetworkhas madeithesitanttorolloutadditionalfibernetwork.

France

At the end ofthe third quarter2008,17.1 millionbroadbandconnectionsexisted inFrance, arate of26.9connectionsper100inhabitants.16.3millionof these connectionswere DSLconnections;the remainderwassplitbetweencable,fiber,wirelessand satellite

(ARCEP2008a).8.2millionDSLconnectionsareprovided bycompetitors oftheincumbent operator,FranceTélécom;6.0millionofthembywayofLLU and 2.2million usingbitstream[1] (ARCEP2008b).At the end of2007,DSL wasavailableto98.2percent ofthe population,whereas cablewasavailable toonly40percent(ARCEP2008c).

Initsdeployment offiber,theFrenchtelecommunicationsmarket isoneof themost competitiveinEurope.Manydifferentoperatorsplantorolloutftth.Thissolution, whichismore radicalthan the Germanstep-by-stepapproach,isalsofavoredbyARCEP,theFrenchregulatoryagency.Thestrategy ofdeploying FTTHinsteadofFTTC isbasedinthe relatively longdistance between the street cabinetand theconsumer in most areas of France. In Germany,the average distance between theconsumer and the street cabinet is 300 meters; in France this distance averages 1 km. Therefore, roll out of fiber to the street cabinet would result in a far lower bandwidth in France than in Germany.

France Télécom began a pre-roll-out of FTTH in several large cities in 2007. Mass-market roll out is planned to take place from 2009 to 2012, aiming at 2 million subscribers by 2012 (cf. Elixmann et al. 2008). France Télécomôs competitors are especially concentrated in the Paris region, profiting from Parisôs unique and ubiquitous sewerage system that provides man-high canals to every house. This system makes the deployment of fiber very easy. Indeed, the carrier Free aims at covering 70 percent of Paris; NeufCegetel already reaches 400,000 homes in Paris and plans to reach 5 million by the end of 2012.

To spur investment in FTTH, ARCEP pursues three main strategies. First, FranceTélécom is required to grant access to its ducts. After surveying France Télécomôs duct facilities in 10

cities, ARCEP concluded the ducts are sufficiently roomy that competitors can roll out their fiber in parallel. Using this space dramatically reduces competitorsô costs of deploying fiber. Second, ARCEP does not consider it economically reasonable to duplicate fiber roll out inside a building and thus desires competitors to coordinate on this front. This view is also held by the French parliament, which, in the Law on Modernizing the Economy (n° 2008ï 776), published 4 August 2008, mandated that new buildings must be equipped with fiber and that the first operator to deploy fiber inside a building must grant access on a non-discriminatory basis (ARCEP 2008d). By contrast, fiber unbundling is not mandated yet and there is no further obligation to provide bitstream access to the fiber network (Elixmann et al. 2008). Third, municipalities are to play an active role in facilitating the fiber roll out by providing information about existing infrastructure and geographical characteristics, co-ordinating street work and negotiations with building owners, and granting access to their own infrastructure, such as sewer systems.

United Kingdom

The British telecommunication market includes 15.6 million broadband connections, of which 14.3 million were residential broadband connections at the end of 2007 (Ofcom 2008a). This results in a broadband penetration rate of 23.5 connections per 100 inhabitants in the United Kingdom. At the end of 2007, 26.3 percent of broadband connections used DSL from British Telecom; British Telecomôs whole sale broadband products accounted for 26.9 percent of the market; 23.7 percent of broadband connections were provided by competitors using the incumbentôs last mile; 21.8 percent used broadband over cable; and 1.3 percent had other types of connections (Ofcom 2008a). Due to increased DSL use (from 10 percent in 2006 to 23.7 percent in 2007), made possible by com- petitors using British Telecomôs last mile via LLU,

British Telecom suffered a massive decline in its wholesale broadband share, which had peaked at 42.3 percent in 2006 (Ofcom 2008a).

The emergence of facility-based competition based on LLU began in 2006 with the functional separation of British Telecom from its local access network. The local access network is now controlled by Openreach, a functionally separated branch of British Telecom. Openreach was founded to guarantee equal access to the local loop for British Telecom and its competitors. With the unbundling of 33.2 percent of all MDFs at the end of the first quarter 2008, competitors can now deliver LLU-DSL to 82.6 percent of all households (Ofcom 2008a).

Several market participants plan to roll out a NGA. In July 2008, British Telecom announced that it would invest EUR 1.78 billion in the roll out of FTTC for 7ï 10 million households by 2012 (Ofcom 2008b). FTTC allows a bandwidth of 40 Mbit/s at first. Newly built houses will be equipped with FTTH, which will allow a bandwidth of 100 Mbit/s and more. A first trial is taking place in Ebbsfleet Valley, Kent, where 10,000 new houses will be equipped with FTTH starting in 2008. In December 2007, Virgin Media, the British cable operator and British Telecomôs main competitor, announced the upgrade of two-thirds of its cable network. This upgrade enables Virgin Media to offer a bandwidth up to 50 Mbit/s to 9 million households since the end of 2008 (Ofcom 2008a). In addition to British Telecom and Virgin Media, smaller entities, including H2O Networks Ltd and the Digital Region Project, are planning to roll out NGA networks in some areas. H2O Networks Ltd has plans to use the municipal sewerage system.

In a report published in September 2008, the British regulatory agency, Ofcom, elaborated on its vision of the regulatory regime during and after the roll out of NGA networks. Ofcom focuses on regulatory certainty, meaning that Ofcomôsdecisions will be ñclear, timely and consistent

over the longer termò (Ofcom 2008b). Ofcom acknowledges that standardized interfaces are very important in providing effective access opportunities for every market participant. Ofcom therefore relies on industry-driven development and supports the formation of industry groups, such as NGN UK or the Network Interoperability Consultative Committee (NICC), to harmonize and support the development of standards. In terms of access, Ofcom remains committed to promoting infrastructural competition at the deepest level possible. Where British Telecom deploys a FTTC network, Ofcom considers it obliged to provide access to the copper wire at the street cabinet. Where British Telecom deploys a FTTH network, Ofcom obligates it to allow fiber or wavelength unbundling or duct access, which means competitors are granted access to British Telecomôs ducts so that they can duplicate the FTTH network for their own use. Ofcom is currently making a survey of British Telecomôs ducts. In September 2008, the Caio Review (2008) recommended strategies to reduce the cost of deploying fiber, such as the co-ordination of street work and the provision of access to public utility ducts and sewers. Based on these recommendations, Ofcom is considering the use of municipal sewerage systems and is carefully examining the French approach. In addition to these ñpassiveò access strategies, Ofcom is also considering ñactiveò access strategies (e.g., bitstream access).

The pricing of access has yet to be decided. The prices of old access products were regulated by Ofcom, but the new prices will be unregulated, at least to begin with. Ofcom is aware of the risk of setting an inap- propriate price and is also cognizant of the uncer- tainty and risk that the investor in NGA is exposed to and therefore wants the market parties to experi- ment with different prices. Excessive pricing does not seem likely due to regulation of other wholesale products, such as DSL access, and competition with cable and wireless NGN products.

Chapter Five
Observations and Recommendations

5.1 Observations

Information infrastructure is obviously an important source of economic and social value, even though it is difficult to quantify precisely the economic value of information services. The strong, two-way link between economic growth and investment in telecommunications infrastructure resonates with the theoretical views of Reich (1991), who sees human capital and infrastructure as key determinants of development, and Porter (1990), who identifies a strong link between economic success and the development of national infrastructure and support (Karlsson, 1993). Nigeria is in a position to be a major player in the information economy, given its enormous human and material resources and large market, and if equipped with Internet gateway/infrastructure and modern fiber-optic infrastructure.

We conclude that different forces are at work, which determine the optimum technological evolution that will lead to decreasing prices, and eventually allow a deeper level of competition. Surfacing concrete demand and willingness to pay also will lead to increased incentives to invest. The government has the means and responsibility to achieve the optimal balance between competition and investment by considering the public value of state-of-the-art telecommunications infrastructure, such as fiber optic network in the Federal Capital Territory. The discussion about the regulation of fiber optic networks in the FCT basically revolves around three themes: access to NGAs (fiber optic), access to ducts, and the phasing out of the traditional copper access network.

Mandating access to NGAs will discourage investment. As long as competitors will incur comparable costs for rolling out a fiber network, competition will ensue, even in the absence of access regulation. Against this background, granting regulatory holidays for NGAs for a given

time period is a misplaced step; new infrastructure components along the NGA should be completely free of regulation. However, it is not economically reasonable to duplicate certain parts of the NGA. This is most obviously true of fiber roll out inside a building, but also for some regions where duplication of a fiber access network would not be profitable. In these cases, national regulatory agencies should consider mandating competitor access to NGA at a regulated price. This price should include an adequate risk premium for the first-mover investor who bears the risk of uncertain future demand and should compensate (***be compensated for?***) for the fact that next-generation facilities can be rolled out at lower cost in the future. Another way of risk sharing is joint investment in NGA by all competitors, which would result in all competitors having access to this joint network at no discriminating prices.

Infrastructure competition will only occur if the costs to roll out the NGA are nearly equal for all competitors. Obviously, however, because the incumbent telecommunication carrier already has access to ducts, its costs will be lower than those of its competitors. Leveling the playing field will require symmetric access regulation of all existing ducts, including both those of the incumbent telecommunication carrier and alternative ducts or sewers. If this symmetric access regulation to ducts guarantees that all competitors will face similar costs of rolling out a fiber network, different strategies for doing so will result, opening the possibility of innovation, instead of simple imitation of the incumbentôs roll-out strategy.

The transition to NGA will make the traditional copper access network obsolete. This has serious implications as to the survival of competitors who at present rely on having access to the incumbentôs local loop. In order to enable these competitors to make feasible plans about their future, it is important to ensure transparency as to the phasing out of the traditional copper access network. This could be achieved by sunset clauses that clearly set forth how long the copper

access network will be available. As it is probably too optimistic to rely on a collective agreement between the incumbent telecommunication carrier and its competitors, national regulatory agencies may need to play a role in ensuring that appropriate transparency is achieved.

5.2 Recommendations

Based on the above observations, the following are recommended:

- State-of-the-art telecommunications infrastructure involves fibre optic deployment in the access network, because this is the only medium
  suitable for offering future-proof bandwidth.
- FCT policy makers should plan for a comprehensive and carefully targeted ICT human capital stock to reap the benefits of fiber optic network and to remedy the challenges of shortage of capital and technology know-how.
- The deployment of fiber demonstrates that the vertical integration of networks and services is being broken up and that different horizontal layers of passive and active infrastructure can be provided by different players. This impacts the design of future business models and also has a significant impact on the investment incentives of different types of players.
- Adequate knowledge of ICT and the adoption of appropriate information technology management principles in addition to building and implementing a sustainable information technology infrastructure- fiber optic network in all government entities.

- Realize that ICT is not Software, Hardware and Networks only, it is much broader than that, have a broader perspective of ICT and be cognizant of the basic requirements and ingredients.
- Have a thorough evaluation and mapping of our institutions and their unique processes, unique management context, inter-relationships and then view ICT as both an actor and enabler.
- Have professionals with adequate ICT knowledge work with knowledgeable institutional professionals who might not necessarily be knowledgeable about ICT but are thorough with the local institutional realities and processes.
- Create an environment to harness private sector investment through partnership with the public sector, including strategic equity partnerships, joint operating schemes and business co-operation contracts.
- One can suggest that public private partnership (PPP) projects are suitable to develop solutions for the deployment of broadband infrastructures particularly in remote areas. But, it needs to be pointed out that their success depends highly on the regulatory, financial and legal environment as well as the willingness of both the public and the private sector to cooperate in a way where everyone can benefit.
- Increase the use of information technology in the public sector via computerization of all government entities and the school system. It is quite important to carefully and gradually adapt e-government and e-commerce.
- Establish information technology community centers across the FCT to enhance access equity, avoiding concentrations only in the urban areas, and provide incentives for private sector participants willing to venture or expand to the villages.

- Market liberalization and openness is crucial to allow the injection of competition and investments. Competition leads to better technical solutions, better delivery of services and lower prices.
- The telecommunication sector should be re-structured and strategically aligned, in order to expand, maximize the utility of its modern infrastructure and attract investment.
- Establish an independent multi-sector regulatory authority, empowered with appropriate legal framework (copyright, security and intellectual property) and competent non-political personnel.
- Develop an FCT information infrastructure strategy, cognizant of the special cultural features of the local people.

The above recommendations are not exhaustive, nor prescriptive, but rather to add to the many suggestions already provided in other similar works.

In order to place the FCT into a viable position to benefit in the current information economy, policy makers must urgently conceive and implement appropriate national information and communication technology (ICT) strategy that will continue to develop and blend with the local and regional context. This will not only facilitate the movement of the economy up the value-added chain, through the ongoing computerization of the FCT, but also place the government in a vantage position to develop, maintain and continue to improve an appropriate ICT infrastructure in form of fiber optic network, and thereby create a positive investment climate capable of attracting both capital investors and sophisticated users to be part of and benefit from the information technology-driven economy.

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